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### Kinds of micro-explanation

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**Theo A. F. Kuipers**

## **KINDS OF MICRO-EXPLANATION**

### **REPLY TO ERIK WEBER AND HELENA DE PREESTER**

The paper by Erik Weber and Helena De Preester is in at least two respects very stimulating. First, it nicely illustrates how my five-steps model of explanation can be adapted to what I would like to call structural explanations of system laws. Second, it provides a clear sight of a (compatible) kind of functional explanation of such laws that is not touched upon in SiS.

#### **Structural Explanation of System Laws**

The explanation elaborated by Weber and De Preester in Section 2 for a circuit law on the basis of my five-steps model of explanation (SiS, Ch. 3) is an excellent and totally unexpected kind of use of that model. More specifically, they convincingly show that an input-output law (L) characterizing the observable behavior of the circuit can be deduced from three “fundamental (individual) laws,” two “interaction principles” and five “bridge principles.” The deduction comprises an aggregation (A) step, followed by a transformation (T) step, hence their speaking of an AT explanation. I have nothing to add to this lucid analysis, just some additional remarks that may further exploit the example.

(1) The aggregation step is a nice example of what was intended with the second (italicized below) half of my elucidation (SiS, p. 87): “the total effect of the individual law for many objects is calculated by a suitable addition, *or composition (or synthesis) if more than one type of individual law is involved,*” since the three individual laws, characterizing the gates, concern two types: AND and XOR gates. Moreover, only in the case of uniformly sequential or parallel grouping of a number of gates of the same type would it be adequate to speak of (straightforward) aggregation.

(2) As a matter of fact, the authors show that the five-steps model, which was primarily intended for the explanation of a law by a theory (indicated in Weber and De Preester’s Section 5.2), can easily be adapted to a model for the

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explanation of a “system law” starting with, instead of a “(theory-) application step,” an “observation step,” as I would like to call it, for it amounts to the establishment of observational laws regarding components of the system. Their fundamental laws amount essentially to thus established laws for the gates in the circuit.

(3) The interaction and bridge principles are essentially identity claims. The first ones claim that certain gate outputs are identical to certain gate inputs. The bridge (or transformation) principles claim that certain gate inputs and outputs are identical to certain circuit inputs and outputs, respectively.

(4) The fundamental laws (or individual gate laws) and the bridge principles (gate identities) constitute together the internal or micro-principles used by the micro-explanation.

(5) The resulting explanation may not only be called a case of micro-reduction due to the (complex) aggregation step, but also a case of identificatory reduction, due to the identity nature of all transformation principles. Hence, apart from the different nature of the (hidden) first step, the example is essentially similar to the reduction of the ideal gas law.

(6) It seems plausible to call the present type of explanation of circuit laws and, more generally, system laws, structural (reductive) explanations, in particular when they are opposed to what Weber and De Preester call functional explanations of such laws, to be discussed now.

### Functional Explanation of System Laws

Inspired by Cummins (1975), Weber and De Preester also give a kind of functional explanation of the same system law, viz. an explanation in terms of function ascriptions to the three gates in the circuit and the assumption that these gates function normally. Again I would just like to make a couple of remarks.

(1) Talking about functions should not hide the fact that the normal functioning of a gate can be described by hybrid behavioral laws, e.g.  $F_a$  and  $N_a$  together imply the law ( $NF_a$ ): “ $output_2(C) = 1$  iff  $input_3(C) = 1$  and  $output(b) = 1$ ,” and the resulting three laws together imply the system law to be explained.

(2) Such hybrid laws can easily be redescribed as bridge principles, from gates to the system or vice versa. For example,  $NF_a$  is equivalent to “if  $output(b) = 1$ , then  $output_2(C) = 1$  iff  $input_3(C) = 1$ , and if  $output(b) = 0$ , then  $output_2(C) = 0$ .” Hence, the resulting explanation fits into the five-steps model in the sense that these laws are in fact transformation principles of the causal correlation type such that the explanation amounts to a number of correlation

steps, with the peculiar fact that they do not start from individual laws of a substantial nature but of a (context-relative) tautological nature, such as “*output(b) = 1* or *output(b) = 0*.” In view of the fact that neither Weber and De Preester’s version nor the indicated nonfunctional version use individual laws, let alone micro-principles giving rise to such laws, it seems less appropriate to talk in this case about micro-explanations, as Weber and De Preester in fact do.

(3) The foregoing remarks are not intended to play down the practical usefulness of normal function talk. As in the case of biological functions, following Ruth Millikan (see SiS, Sections 4.2 and 6.2), if adapted, function talk makes also perfect sense in the case of artificial functions. As a matter of fact, whereas ascriptions of biological functions are essentially based on at least two causal components, one of a proximate and one of an ultimate nature, artificial function ascriptions may be based on merely one type of causal laws, as NF<sub>a</sub> illustrates. Weber and De Preester’s contribution strongly suggests that a further general analysis of functional explanations related to artificial systems along the lines of “explanation by specification” as developed in Chapter 4 of SiS would be very interesting.

(4) Very illuminating is the “multiple realizability” that Weber and De Preester discuss in Section 4. The same functions that are played by the gates can be realized in other ways than the particular “material realizations” in the sample circuit. I would like to add that the reductive explanation of the circuit law in Section 2 provides a perfect “artificial” illustration of the compatibility of multiple realizability and reductive explanations. As suggested in SiS (e.g. pp. 154-5) with some examples from natural science, the popular claim in functionalist philosophy of mind by Fodor and Putnam that multiple realizability is a blockade for reduction, is due to a lack of understanding of successful reductive arguments in the natural sciences.

(5) Finally, Weber and De Preester go as far as to claim that a functional explanation of the circuit law is not theoretically interesting and only practically useful, i.e. useful for manipulation of the circuit and, I would like to add, diagnostic reasoning about it, if the relevant structural explanation is available as well. This agrees with my claim (SiS, p. 126): “Explanation by a certain type of specification [intentional, functional, causal] automatically leads to a corresponding type of description, in particular classification.” In other words, (isolated) functional explanations are in a sense merely a kind of description. However, as indicated in the contribution of Grobler and Wiśniewski and my reply to them, in special cases, they may play an important role in the evaluation of theories.

**REFERENCE**

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